

Pioneer Mission Support

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This article reports on activities within the Deep Space Network in support of the Pioneer Project's in-flight spacecraft during the period December 1976 through March 1977. The amount of tracking coverage provided by the Network and a summary of operational testing of the Mark III Data Subsystems are presented.

I. Pioneers 6, 7, 8, and 9

Coverage of these spacecraft has continued at minimal levels. During the period December 1976 through March 1977, Pioneers 6 and 9 were each tracked once whereas Pioneer 7 was tracked four times. Total tracking coverage times appear in Table 1.

Tracking of Pioneer 7 was performed in support of an opportunity for the spacecraft to observe the geomagnetic tail. Data obtained early in the Pioneer missions indicated that the position of the geomagnetic tail varies considerably due to interaction with the solar wind. It was anticipated that Pioneer 7 might observe the tail as the Earth passed between the Sun and the spacecraft. However, no net change in flux was observed, indicating that the spacecraft probably did not enter the tail. Figure 1 illustrates the geometry of the event.

II. Pioneers 10 and 11

A. Mission Operations and Status

Pioneer 10 continues to operate satisfactorily. The spacecraft is now more than 13 astronomical units (AU) from the Earth and the round trip light time is over 3 hours 45 minutes. Tracking coverage has decreased from the levels reported earlier (Ref. 1), due primarily to the extreme spacecraft range that requires coverage by the 64-meter stations. Tracking times for the last four months are listed in Table 1. Figure 2 presents a histogram of Pioneer 10 coverage for the last twelve months.

Pioneer 11 is also operating satisfactorily. The distance to the spacecraft is now more than 5 AU and the round trip light time is over 1 hour 25 minutes. Tracking coverage is shown in Table 1 and Fig. 3.

The use of thruster pair No. 2 on Pioneer 11 has been discontinued due to the development of a serious leak in the valve seals. This thruster pair had been used since last October, when a leak was detected in pair No. 1. The leak rate from pair No. 1 has decreased since then and the Project has lengthened the thruster pulse duration from one-eighth to one second to decrease the number of valve actuations required. The velocity change resulting from the use of pair No. 1 has not yet been explained, but the effect will be used to perform a trajectory correction maneuver without using the ΔV thrusters. It has been determined that the use of thruster pair No. 1 in accomplishing precession maneuvers will, by the end of 1977, provide a sufficient ΔV to refine the spacecraft targeting for Saturn encounter.

B. Mark III Data Subsystems Support of Pioneer

Since the previous report (Ref. 1), Mark III Data System (MDS) verification testing for Pioneers 10 and 11 has been completed at DSSs 12, 44, and 62. Configuration control for

Pioneer was established on 26 January for DSS 12, 1 March for DSS 62, and on 22 March for DSS 44. Table 2 is a listing of the demonstration passes that were performed by these stations and a summary of the problems encountered. All major anomalies have been cleared by the issuance and successful demonstration of either updated software or hardware changes.

Future updates to the command and telemetry programs will enable the MDS-equipped stations to support the Pioneer 6, 7, 8, and 9 missions. A series of demonstration passes will be conducted with the stations when these programs are completed and released to operations.

DSS 14 is currently undergoing upgrading to a MDS configuration. Verification testing of this station for Pioneer support will follow the same pattern of demonstration passes as was used for DSSs 12, 44, and 62. A future article will report on this testing.

Reference

Adamski, T.P., "Pioneer Mission Support," in *The Deep Space Network Progress Report 42-37*, pp. 35-38, Jet Propulsion Laboratory, Pasadena, Calif., February 15, 1977.

Table 1. Pioneer tracking coverage

Month	Spacecraft	Station type	Tracks	Tracking time, h:m
December	Pioneer 10	26-meter	7	47:31
		64-meter	34	231:14
	Pioneer 11	26-meter	70	513:48
		64-meter	1	2:53
January	Pioneer 10	26-meter	1	2:00
		64-meter	40	328:53
	Pioneer 11	26-meter	66	518:46
		64-meter	4	23:54
February	Pioneer 6	26-meter	1	5:45
	Pioneer 7	26-meter	4	42:34
	Pioneer 9	26-meter	1	3:56
	Pioneer 10	26-meter	2	11:39
		64-meter	29	194:41
	Pioneer 11	26-meter	39	301:34
		64-meter	7	45:06
March	Pioneer 10	26-meter	1	2:52
		64-meter	33	187:41
	Pioneer 11	26-meter	68	521:04
		64-meter	4	23:54

Table 2. Pioneer MDS demonstration pass summary

Date	DSS	Duration (h:m)	Spacecraft	Anomalies
12/28/76	12	6:28	11	<ul style="list-style-type: none"> (1) Unable to either receive text predicts at DIS or transfer binary predicts to MDA. No DIS/SSC interface (2) Unable to access CPA for command data transfer. Suspected comm buffer interface or SSC problem (3) Unable to output radio metric data until MDA was reloaded (4) Transmitter failed twice. Bad thermal switch on klystron magnet (5) DIS failed due to blown fuse in memory +25 volt power supply (6) Unable to process radio metric data at NOCC. Procedural error (required software patches had not been made) (7) Lost all output twice due to nondirected reconfigurations of the star switch map
1/3/77	12	5:52	11	<ul style="list-style-type: none"> (1) Unable to establish interface between CMF 1 and comm buffer 1 with program DMH-5115-OP-A until (required) patches per ECO 76.249 were deleted (2) Transmitter failed due to insufficient magnet coolant flow (3) Unable to process radio metric data at NOCC. Procedural error (required software patches had not been made) (4) A manual command remained in the command stack after it was confirmed. Procedural error (command had been promoted from the manual buffer twice) (5) TPA failed when receivers dropped lock at two-way acquisition (6) Telemetry time errors following bit rate change. Procedural error due to incorrect documentation
1/13/77	12	2:37	10	<ul style="list-style-type: none"> (1) Test terminated early due to severe timing problems on-site
1/21/77	12	5:53	11	<ul style="list-style-type: none"> (1) Lost output due to nondirected reconfiguration of the star switch map (2) TPA 2 failed. Stopped processing and did not go into TODR mode (which was enabled) (3) DIS stopped updating, apparently due to bad DIS/SSC interface (4) Unable to restrict telemetry recalls to a single UDT. Procedural error with program initialization (5) Signal level in error by 4 dB due to bad calibration curve
1/26/77	12	5:26	11	<ul style="list-style-type: none"> (1) TPA 2 failed three times during the pass
2/2/77	62	7:02	11	<ul style="list-style-type: none"> (1) DIS failed after losing interface with TPA 1. Program reloaded (2) Lost all output due to nondirected reconfiguration of star switch map (3) CMF 1 failed, displaying an indeterminable timing error (4) TPA 1 failed. Possible problem with TODR operation

Table 2. (contd)

Date	DSS	Duration (h:m)	Spacecraft	Anomalies
2/5/77	62	6:36	11	(1) Nondirected reconfiguration of star switch map (2) CMF 1 failed twice. Program reloaded each time
2/6/77	62	8:47	11	(1) Unable to complete command checkout due to loop-back of HSDL at some unknown location (2) CMF 1 failed twice. Program reloaded each time (3) Both CPAs aborted commands due to data quality alarms. Reconfigured to short-loop (CMA internal) confirmation
2/9/77	62	9:34	11	(1) Lost output due to nondirected reconfiguration of star switch map (2) Observed erroneous antenna mode status in monitor data. Known software problem
2/15/77	62	12:19	11	(1) Procedural error in entering manual command (command entered in wrong CMA mode) (2) Lost ten minutes of DODR due to rewind after write errors and no switching to backup transport
2/16/77	62	9:00	11	(1) Nondirected reconfiguration of star switch map
3/4/77	44	6:31	11	(1) Lost CMF/comm buffer interface during data transfer (2) DIS incorrectly indicating antenna mode and angle data type. Known software anomaly (3) Unable to initiate or terminate CONSCAN AGC data via DIS CRT keyboard. Entries accepted via DIS local I/O (4) TPA 2 unable to lock to 64 bps coded data due to unstable SSA lock (5) CMF stopped logging a DODR due to no fresh tape available after attempted tape switch
3/8/77	44	4:17	11	(1) MDA halted due to failure of TermiNet I/O device (2) DIS incorrectly flagging antenna mode and angle data type. Known software anomaly
3/12/77	44	6:15	11	None
3/17/77	44	3:30	11	None
3/20/77	44	6:20	11	None

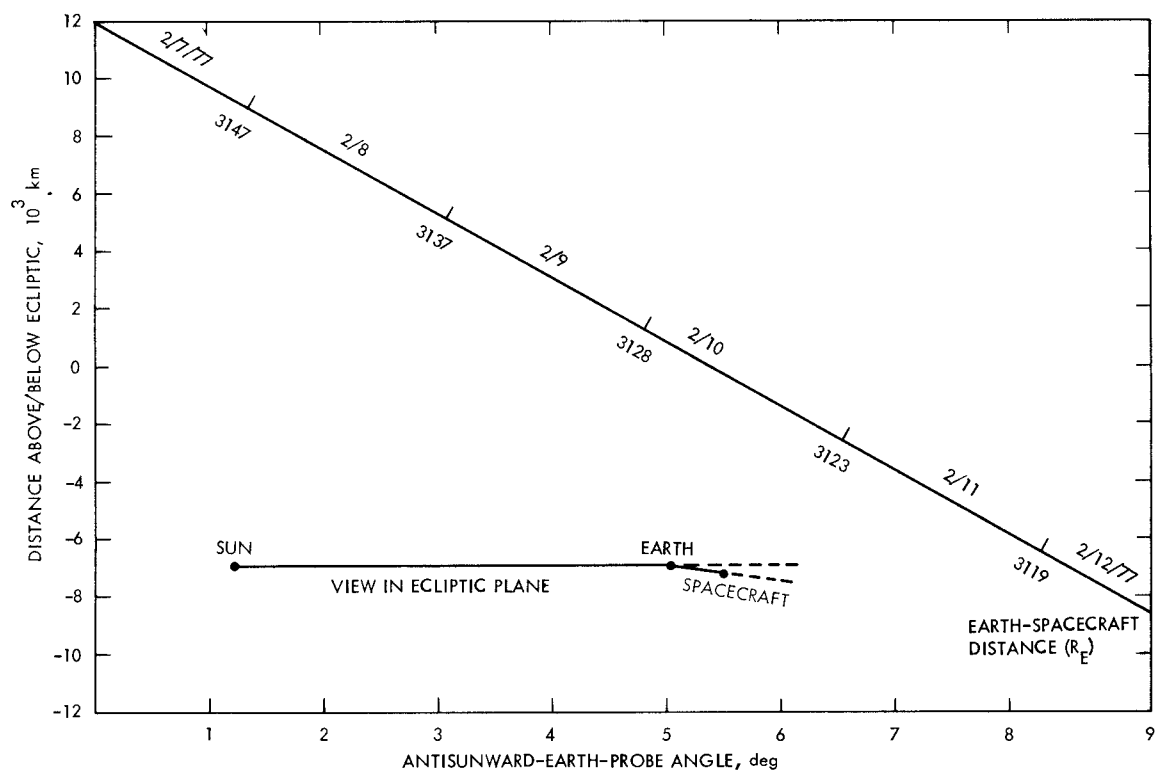


Fig. 1. Pioneer 7 trajectory

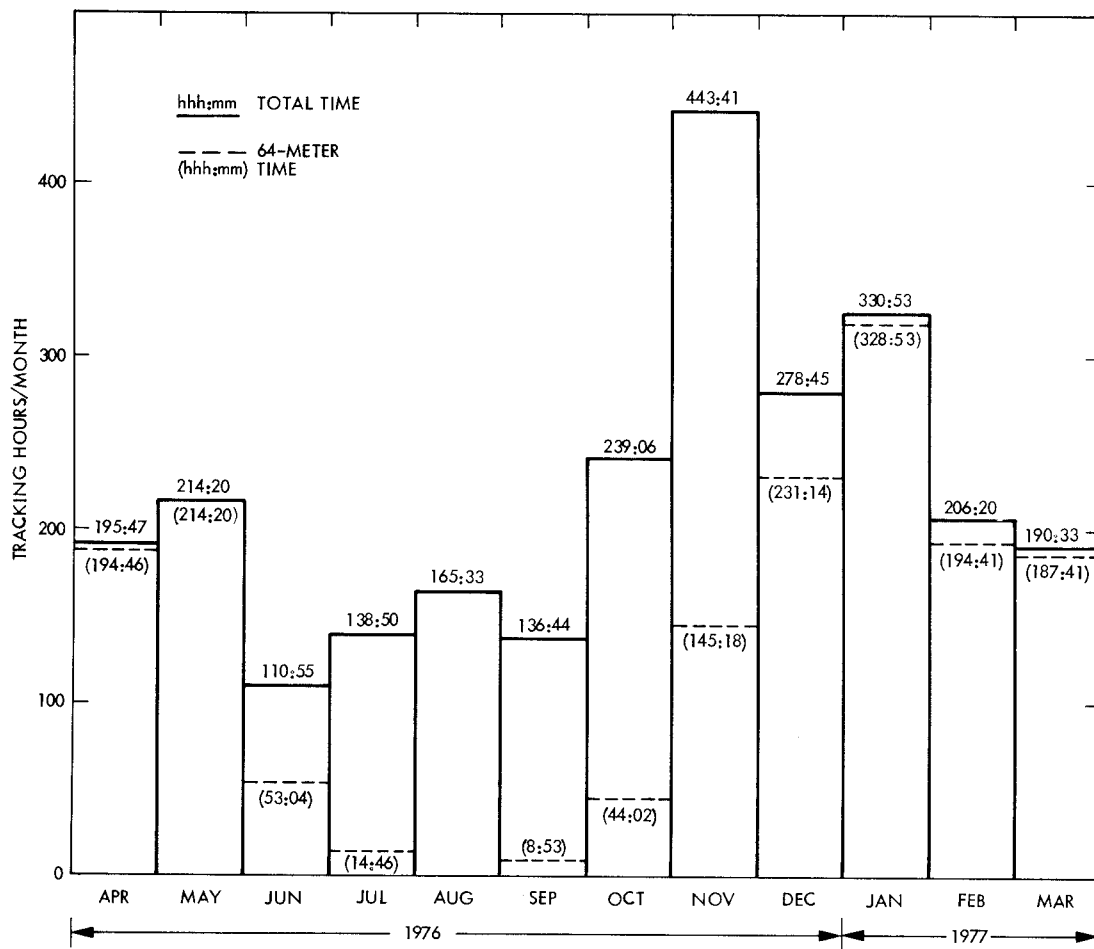


Fig. 2. Pioneer 10 tracking times

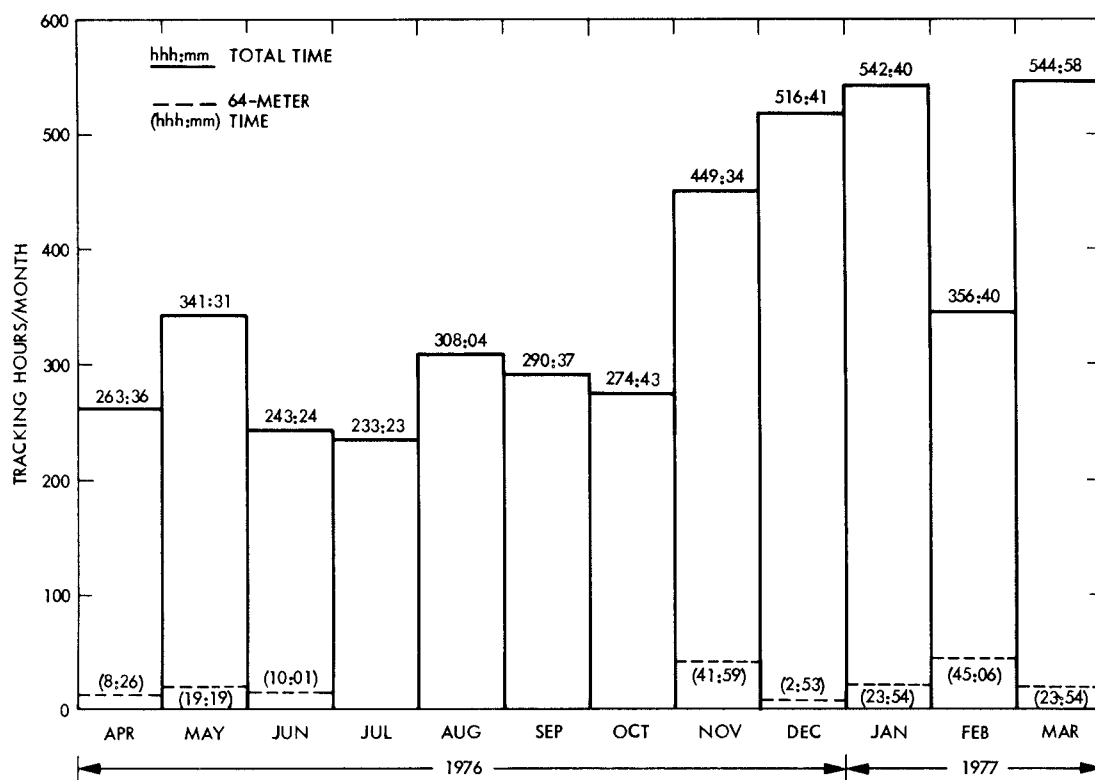


Fig. 3. Pioneer 11 tracking times